

WHAT IS CLAIMED IS:

1. A semiconductor device comprising:

a first inter-layer insulation film formed over a substrate and including a first low dielectric constant film and a hydrophilic insulation film formed on the first low dielectric constant film;

a first interconnection layer buried in a first interconnection trench formed in the first inter-layer insulation film, whose minimum interconnection pitch is a first pitch;

a second inter-layer insulation film formed over the first inter-layer insulation film and including a second low dielectric constant film;

a second interconnection layer buried in a second interconnection trench formed in the second inter-layer insulation film, whose minimum interconnection pitch is a second pitch larger than the first pitch; and

a diffusion preventing film formed directly on the second low dielectric constant film and the second interconnection layer.

2. A semiconductor device according to claim 1, further comprising:

a third inter-layer insulation film formed over the second inter-layer insulation film and including an insulation film having a dielectric constant higher than the first low dielectric constant film and the second low

dielectric constant film; and

a third interconnection layer buried in a third interconnection trench formed in the third inter-layer insulation film, whose minimum interconnection pitch is a third pitch larger than the first pitch and the second pitch.

3. A semiconductor device according to claim 1, further comprising

a diffusion preventing film formed directly on the hydrophilic insulation film and the first interconnection layer.

4. A semiconductor device according to claim 2, further comprising

a diffusion preventing film formed directly on the hydrophilic insulation film and the first interconnection layer.

5. A semiconductor device according to claim 1, wherein

the second pitch is 1.5 or more times the first pitch.

6. A semiconductor device according to claim 2, wherein

the second pitch is 1.5 or more times the first pitch.

7. A semiconductor device according to claim 1, wherein

the low dielectric constant film is an SiOC film, a SiLK film, a BCB film, a FLARE film or a porous silicon oxide film.

8. A semiconductor device according to claim 1, wherein

the interconnection layer is buried in a via hole formed in the inter-layer insulation film and in the interconnection trench formed in a region of the inter-layer insulation film, which includes the via hole.

9. A semiconductor device according to claim 1, wherein

a main material of the interconnection layer is Cu or Al.

10. A semiconductor device comprising:

a first multilayer interconnection layer formed over a substrate and including a plurality of interconnection layers whose minimum interconnection pitch is a first pitch; and

a second multilayer interconnection layer formed over the first multilayer interconnection layer and including a plurality of interconnection layers whose minimum interconnection pitch is a second pitch larger than the first pitch,

at least one of said plurality of interconnection layers forming the first multilayer interconnection layer being buried in an opening formed in a first inter-layer

insulation film including a first low dielectric constant film and a hydrophilic insulation film formed on the first low dielectric constant film,

the respective plurality of interconnection layers forming the second multilayer interconnection layer being buried in an opening formed in a second inter-layer insulation film including a diffusion preventing film and a second low dielectric constant film formed on the diffusion preventing film, and

the diffusion preventing film of one second inter-layer insulation film being formed directly on the second low dielectric constant film of another second inter-layer insulation film underlying said one second inter-layer insulation film.

11. A semiconductor device according to claim 10, further comprising

a third multilayer interconnection layer formed over the second multilayer interconnection layer and including a plurality of interconnection layers whose minimum interconnection pitch is a third pitch larger than the first pitch and the second pitch,

the plurality of interconnection layers forming the third multilayer interconnection layer being buried in an opening formed in a third inter-layer insulation film including an insulation film of a higher dielectric constant than the first low dielectric constant film and

the second low dielectric constant film.

12. A method for fabricating a semiconductor device comprising the steps of:

forming over a substrate a first inter-layer insulation film including a first low dielectric constant film and a first hydrophilic insulation film formed on the first low dielectric constant film;

forming a first interconnection trench in the first inter-layer insulation film;

forming a first conductor film on the first inter-layer insulation film with the first interconnection trench formed in;

polishing the first conductor film to expose the first hydrophilic insulation film while burying the first conductor film in the first interconnection trench to form a first interconnection layer whose minimum interconnection pitch is a first pitch;

forming a second inter-layer insulation film including a second low dielectric constant film over the first inter-layer insulation film;

forming a second interconnection trench in the second inter-layer insulation film;

forming a second conductor film on the second inter-layer insulation film with the second interconnection trench formed in; and

polishing the second conductor film to expose the

second low dielectric constant film while burying the second conductor film in the second interconnection trench to form a second interconnection layer whose minimum interconnection pitch is a second pitch larger than the first pitch.

13. A method for fabricating a semiconductor device according to claim 12, further comprising, after the step of forming the second interconnection layer, the step of

forming a diffusion preventing film directly on the second low dielectric constant film and the second interconnection layer.

14. A method for fabricating a semiconductor device according to claim 12, wherein

in the step of forming the first conductor film, the first conductor film including a barrier metal layer and a metal layer formed on the barrier metal layer is formed,

in the step of forming the first interconnection layer, the metal film is polished selectively with respect to the barrier metal layer, the polish is stopped on the surface of the barrier metal layer, and then the barrier metal layer is polished to expose the first hydrophilic insulation film.

15. A method for fabricating a semiconductor device according to claim 13, wherein

in the step of forming the first conductor film, the

first conductor film including a barrier metal layer and a metal layer formed on the barrier metal layer is formed,

in the step of forming the first interconnection layer, the metal film is polished selectively with respect to the barrier metal layer, the polish is stopped on the surface of the barrier metal layer, and then the barrier metal layer is polished to expose the first hydrophilic insulation film.

16. A method for fabricating a semiconductor device according to claim 12, wherein

the step of forming the second inter-layer insulation film includes the step of forming a second hydrophilic insulation film on the second low dielectric constant film, and

in the step of forming the second interconnection layer, the second conductor film and the second hydrophilic insulation film are polished to expose the second low dielectric constant film.

17. A method for fabricating a semiconductor device according to claim 13, wherein

the step of forming the second inter-layer insulation film includes the step of forming a second hydrophilic insulation film on the second low dielectric constant film, and

in the step of forming the second interconnection

layer, the second conductor film and the second hydrophilic insulation film are polished to expose the second low dielectric constant film.

18. A method for fabricating a semiconductor device according to claim 16, wherein

in the step of forming the second conductor film, the second conductor film including a barrier metal layer and a metal film formed on the barrier metal layer, and

in the step of forming the second interconnection layer, the metal film is polished selectively with respect to the barrier metal layer, the polish is stopped on the surface of the barrier metal layer, and then the barrier metal layer and the second hydrophilic insulation film are polished to expose the second low dielectric constant film.

19. A method for fabricating a semiconductor device according to claim 16, wherein

in the step of forming the first inter-layer insulation film, the first hydrophilic insulation film is formed in a larger thickness than the second hydrophilic insulation film.

20. A method for fabricating a semiconductor device according to claim 12, further comprising, after the step of burying the first conductor film in the first interconnection trench, the step of

removing foreign matters by HF processing.